Listing of Claims

1. (Currently Amended) A method of preparing a porous low-k dielectric film on a substrate, the method comprising:

(a) forming a precursor film on the substrate in a first chamber, the precursor film comprising a porogen and a structure former;

(b) exposing the precursor film to a plasma in the first chamber to remove at least a substantial portion of the porogen from the precursor film to thereby form a porous low-k dielectric film, wherein the plasma exposure time is between about 10 seconds and 1 minute; and

(c) treating the film by exposing the substrate to an e-beam or UV radiation in a second chamber to remove additional porogen from the film, thereby increasing the porosity of the porous low-k dielectric film and to increase the mechanical strength of the porous low-k dielectric film.

2. (Canceled)

3. (Original) The method of claim 1, wherein the precursor film comprises a porogen and a silicon-containing structure former.

4. (Original) The method of claim 1, wherein the precursor film is formed by co-depositing the porogen with the structure former.

5. (Currently Amended) The method of claim 1, wherein the structure former is produced from at least one precursor selected from the group consisting of ~~silane,~~ an alkylsilane, an alkoxysilane, and a siloxane.

6. (Original) The method of claim 5, wherein the at least one precursor is selected from the group consisting of diethoxymethylsilane (DEMS), octamethylcyclotetrasiloxane (OMCTS), tetramethylcyclotetrasiloxane (TMCTS), trimethylsilylacetylene (TMSA), bis-trimethylsilylacetylene (BTMSA), and combinations thereof.

7. (Original) The method of claim 1, wherein the porogen comprises a polyfunctional cyclic non-aromatic compound.

8. (Currently Amended) The method of claim 7, wherein the polyfunctional cyclic non-aromatic compound is 5-ethylidene-2-norbornene (ENB) or a pinene ~~piene~~ compound.

9. (Original) The method of claim 1, wherein the precursor film is formed by a chemical vapor deposition (CVD) process.

10. (Original) The method of claim 9, wherein the precursor film is formed by a plasma enhanced chemical vapor deposition (PECVD) process.

11. (Canceled)

12. (Original) The method of claim 1, wherein the porous low-k dielectric film is an organosilicate glass (OSG).

13. (Original) The method of claim 1, wherein, after (c), the low-k dielectric film has a dielectric constant that is about 2.5 or lower.

14. (Original) The method of claim 1, wherein the first chamber is a PECVD chamber.

15. (Currently Amended) The method of claim 1, wherein the plasma in (b) removes between about 5% and 50 ~~90~~ % of the porogen from the precursor film.

16. (Currently Amended) The method of claim 1, wherein the plasma in (b) comprises hydrogen gas, helium, argon, nitrogen gas, carbon dioxide gas or a combination thereof.

17. (Currently Amended) The method of claim 1, wherein the gas-flow rate ranges between about 100 sccm and about 10,000 sccm for the plasma exposure in (b) ~~treatment~~.

18. (Currently Amended) The method of claim 1, wherein the chamber pressure of the first chamber ~~ranges~~ is between about 0.5 Torr and about 20 Torr.

19. (Original) The method of claim 1, wherein the plasma in (b) is provided by a dual RF source with a high frequency component power ranging between about 0.1 and about 20 W/cm^2 and a low frequency component power ranging between about 0.1 and about 20 W/cm^2.

20. (Original) The method of claim 1, wherein the plasma in (b) is provided by a single frequency RF source.

21. (Original) The method of claim 1, wherein during (b) the substrate temperature is between about 100 and about 500 degrees Celsius.

22. (Canceled)

23. (Currently Amended) The method of claim 1, wherein the first and second chambers are both ~~in separate chambers~~ in ~~a~~ the same multi-chamber apparatus.

24. (Original) The method of claim 1, wherein the first and second chambers are vacuum integrated.

25. (Currently Amended) The method of claim 1, wherein (a) and (b) are repeated a number of times to build up a desired thickness of the ~~precursor~~ porous low-k dielectric film before (c).

26. (Canceled)

27. (Original) The method of claim 1, wherein the treatment in (c) comprises exposing the substrate to UV radiation.

28. (Original) The method of claim 27, wherein the UV radiation comprises a spectrum peak at a wavelength at or near an absorption peak of the porogen.

29. (Original) The method of claim 27, wherein the UV radiation comprises a wavelength or distribution of wavelengths within the range of about 156 nm to about 500 nm.

30. (Original) The method of claim 27, wherein UV radiation intensity is at least about 200 mW/cm^2.

31. (Original) The method of claim 27, wherein exposure to UV radiation occurs for a time period ranging between about 1 second and about 30 minutes.

32. (Original) The method of claim 27, wherein the substrate temperature during UV radiation exposure ranges between about 25 and about 450 degrees Celsius.

33. (Original) The method of claim 27, wherein exposing the dielectric material to UV radiation takes place in an inert gas, reducing gas or oxidizing gas environment.

34. (Original) The method of claim 27, wherein exposing the dielectric material to UV radiation takes place takes place under vacuum conditions.

35. (Original) The method of claim 1, wherein the treatment in (c) comprises exposing the substrate to an e-beam.

36. (Currently Amended) A method of preparing a porous low-k dielectric layer on a substrate in a multi-chambered tool with vacuum integrated chambers, the method comprising:

(a) forming a precursor film on the substrate in a first chamber of the multi-chambered tool, the precursor film comprising a porogen and a structure former;

(b) exposing the precursor film to a plasma in the first chamber of the multi-chambered tool to remove at least a substantial portion of the porogen from the precursor film to thereby form a porous low-dielectric layer, wherein the plasma exposure time is between about 10 seconds and 1 minute; and

(c) removing the substrate from the first chamber and placing the substrate in a second chamber of the multi-chambered tool.

(d) treating the layer by exposing the substrate to an e-beam or UV radiation in the second chamber of the multi-chambered tool to remove additional porogen from the film, thereby increasing the porosity of the porous low-k dielectric layer and to increase the mechanical strength of the porous low-k dielectric layer.

37. (Canceled)

38. (Currently Amended) The method of claim 36, wherein (a) and (b) are repeated a number of times to build up a desired thickness of the porous low-k dielectric ~~precursor~~ layer before (c).

39. (Original) The method of claim 36, wherein (c) is performed using a robot wafer handler.

40. (Original) The method of claim 36, wherein (c) is performed while the substrate is exposed to vacuum conditions.